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FOUNDRY TRADE JOURNAL
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Vol. 69 Thursday, March 11, 1943 No. 1386

A Splendid Record

With the continuation of wartime conditions, the Proceedings of the Institute of British Foundrymen appear to grow thinner, but this does not mean that a smaller volume of technical matter is being given. Actually, there are 45 more pages than last year, and the attentuation is due to using a lighter weight paper. The standard of the Papers included is, generally speaking, higher than in pre-war days, and there is certainly a better balance in respect to the field covered. Steelfounding is covered by two Papers, from Mr. Kain and Mr. Saunders and from Mr. Kelly. Malleable casting also has two, the one on Arma-Steel, by Mr. C. F. Joseph, being the American Exchange Paper, and the other on the whiteheart process by Mr. A. E. Davies. High-duty irons are given much prominence, as they well merit, and there are four noteworthy contributions by Mr. W. W. Braidwood, Mr. J. Blakiston, Dr. Everest and Mr. A. E. McRae Smith. The non-ferrous foundrymen should be well satisfied with the contributions covering their needs. The Reports on low-tin and tin-free bronzes have received approbation from the highest authorities. The great usefulness of Mr. Machin's Paper became immediately apparent with the entry of Japan into the war, for there is undoubtedly a wealth of practical experience disclosed. Finally, the Paper on die castings, by the late Mr. J. H. Maybrey, deals with a subject the literature of which is still too small in relation to its commercial development.

Topical, but of lasting value, are two Papers dealing with economies to be associated with the industry. Mr. Walker and his colleague Mr. F. Smith have an up-to-date Paper on fuels and furnaces for the heat-treatment of steel castings, and Mr. W. Y. Buchanan on the salvage and disposal of foundry waste. The former was really necessary, for investigations carried out during the early part of the war revealed that the temperature variations in some steel heat-treating furnaces were of such a magnitude as to be a positive danger. The inclusion of Mr. Webster's Paper on the hydro-blast system was certainly called for, as it revealed that the present methods bear no relation whatsoever to those early attempts seen by many British foundrymen at Mannheim and which were rightly ignored by the industry as being unsuited to its local conditions. The process detailed by Mr. Webster is novel and worthy of detailed study. The listing of four Papers which under normal circumstances would be included in the volume is a nice gesture, for at least two of these have been reprinted in full by various sections of the American Press.

The reading of the annual report is particularly pleasing, for it clearly shows that the increasing financial strength is not being obtained by parsimony in respect of the services it gives to its individual members. We congratulate the President, Major Miles, and his colleagues, especially those on the permanent staff of the Institute, on having been able to make such noteworthy progress under such adverse conditions.

Raw Material Needs for Aluminium.—To produce 1 lb. of aluminium, 2 lbs. of aluminium oxide made from 4 lbs. of bauxite are consumed, states T. B. Jolly, vice-president of Alcoa. In addition, 10 kw.-hrs. of electricity is required to separate the aluminium from the oxygen and ¼ lb. of carbon electrode is burned. From start to finish for the manufacture of metallic aluminium, 9 lbs. of raw material is required to make 1 lb. of aluminium from high-grade ore. The lower grades of bauxite require more ore and also additional amounts of other materials.

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CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Melting Furnace Economy

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have had occasion to read through again as a whole the Paper and discussion on "Fuel Conservation in Brass and Iron Foundries," recently reported in THE FOUNDRY TRADE JOURNAL. My interest at the moment is in the application to non-ferrous melting practice, and I make the following observations based on a long experience.

Much non-ferrous melting is done in crucibles, and as under correct conditions the crucible provides considerable protection to the metal during melting, the minimum deterioration occurs. Where a superior grade of metal of high and consistent physical properties is required, this fact alone is sufficient to maintain the pre-eminent position of crucible melting. Where oil fuel is used, the maintenance and control of fuel economy is relatively simple, and where the clearly stated recommendations are followed, no difficulty should be experienced.

Many foundries, however, are still using old-fashioned coke-fired natural-draft pit furnaces. If we accept the fact that an average fuel ratio for a correctly run forced-draft coke furnace should be approximately 1:4½ or 1:5, then 99 out of every 100 natural-draft coke-fired furnaces are hopelessly inefficient; and not only inefficient as regards fuel economy, but in speed of melting also.

The trouble with the natural-draft coke-fired furnace is that in only a very few exceptional cases is it possible to provide a sufficiently high chimney stack to ensure an adequate air supply. This can be overcome, however, by enclosing the ashpit and providing forced draft from a blower. In most cases, this is a practical and easily arranged conversion which can be carried out cheaply. The small conversion and running costs will be more than recovered by the economy and speedier melting resulting. Where gas can be obtained locally at low rates (4d. per therm or under), it may be more advantageous, all things considered, to change over to gas firing.

The point I want to emphasise most strongly is that the day of the natural-draft coke-fired furnace is over. The call for national fuel economy demands the conversion of coke-fired pit furnaces to forced draft, but such a conversion is equally necessary in the economic and practical interests of the individual firm as well. To those in doubt, advice and guidance in arranging a conversion could be given by the non-ferrous section of the technical committee of the Institute of British Foundrymen, or no doubt the crucible and furnace manufacturers would gladly give assistance.

One other matter: a letter from Mr. W. Williams as a contribution to the discussion on the above-mentioned Paper (THE FOUNDRY TRADE JOURNAL, December 10, 1942), makes statements regarding a comparison between Sklenar furnace melting and crucible melting which are inexplicable and misleading, and cannot be allowed to pass unchallenged. Dealing only with two points, the statement is made that . . . "the losses in these Sklenar furnaces are not in excess of 0.75 per cent. for good-quality gunmetal, *i.e.*, about *half* the losses experienced in the crucible types" (the italics are mine). The inference is that the average metal loss with crucible melted gunmetal is about 1.5 per cent.—a figure which is ridiculous.

My own experience indicates a metal loss for crucible melted gunmetal of from 0.2 to 0.5 per cent., depending on the conditions. In a direct comparative test between oil-fired crucible melting and an open-flame Sklenar furnace, melting the same varied range of non-ferrous compositions, melting losses of 0.26 and 2.16 per cent. respectively were obtained. Seven years ago I wrote*:—". . . A point which is often overlooked when the non-crucible furnace is being considered is that the absence of a crucible would appear to effect a substantial saving owing to the lower fuel consumption and absence of crucible replacement costs; but it is necessary to remember that the effect of a greatly increased melting loss can more than offset this gain, and the net result, where high-grade and comparatively costly alloys are being melted is in favour of the crucible type . . ."—words which are still true to-day. From the present national point of view, loss of metal is even more serious than loss of fuel.

Further on, the statement is made that . . . "Also, and this is the most important factor where high duty (strength and homogeneity for pressure resisting) is required, the heating conditions of this type produce the superior quality. . . ." If this is to be taken as referring to crucible melting, it is a perfectly good statement; but if, as appears from the context, it is taken to mean the conditions of the Sklenar furnace, then it is quite misleading.—Yours, etc.,

A. LOGAN.

Farnham Royal, Bucks.

NOTES FROM THE BRANCHES

London.—The next meeting is to be held on Saturday, March 20, at 3 p.m., in the Lecture Theatre of High Duty Alloys, Limited, at Slough, when Mr. E. W. Harding, of the International Meehanite Metal Company, Limited, will, by means of coloured films and slides, open a discussion on "Runners and Risers." The discussion will, by courtesy of the directors of High Duty Alloys, Limited, be followed by an inspection of their very extensive research laboratories.

The scrap collection campaign which was sponsored by all American newspapers has yielded more than 6,000,000 net tons of steel scrap and other old materials. The present national average is 82 lbs. of scrap per person. Kansas leads with 158.7 lbs., with Vermont next at 155.4 lbs. per person.

* Methods and equipment in the non-ferrous foundry.—"Metal Industry," Jan. 17, 1936.

FACTORS INFLUENCING THE FLUIDITY OF CAST IRON*

By G. BURGESS

How temperature composition, oxide skin and viscosity affect the fluidity of cast iron, and some measurements using the spiral test

Fluidity is defined as "the property that metals have of flowing freely and so of filling readily the cavity of a mould," in a Paper entitled "The Fluidity of Molten Metals," presented by Desch to the Sheffield Branch of the Institute in 1921, and covers that property of cast iron and metals in general, which has been variously referred to as "flowing-power," "castability," "life," etc. The unwillingness of foundrymen to use the word "fluidity" arises from their desire not to be confused with the old and now obsolete scientific definition of fluidity which was the reciprocal of the coefficient of viscosity and was therefore a physical constant. Fluidity as it is known by the foundryman is covered by the much wider definition as given previously, and which is the resultant of several factors, and it is this wider definition which is to be considered in this Paper.

That the actual viscosity of the metal plays a very small part towards the final fluidity was shown by Desch in the Paper. In it he described methods of testing the viscosity of various non-ferrous metals by means similar to those used for lubricating oils, etc. It was found impracticable to apply these tests to cast iron and steel on account of their high melting points, but probably it can be assumed that they will follow the same rule as the non-ferrous metals. The result of these tests are summarised as follow:—"It was sometimes thought that metals were rather sluggish—watching a molten metal flowing, it seemed rather sluggish; but when it came to measuring the true viscosity it was found that most metals were only from two to three times as viscous as water."

He also described a form of spiral test used by Saito and Hayashi, two Japanese workers at the University of Kyoto in 1919, to determine the differences in fluidity of various metals and alloys. This test was later accepted in America as the standard fluidity test for cast irons and non-ferrous metals. A form of this test is also in everyday use at the foundry to which the author is attached, the difference being that the Japanese and American spirals were run from the outside end of the spiral and in the case of the Japanese spiral, included a riser in the centre, whereas the spiral used personally and shown in Fig. 1 is run at the centre and has no riser. As will be seen, the fluidity of the metal is directly proportional to the length of the spiral, which is measured

* A Paper presented to the West Riding Branch of the Institute of British Foundrymen, Mr. F. Oldershaw, presiding.

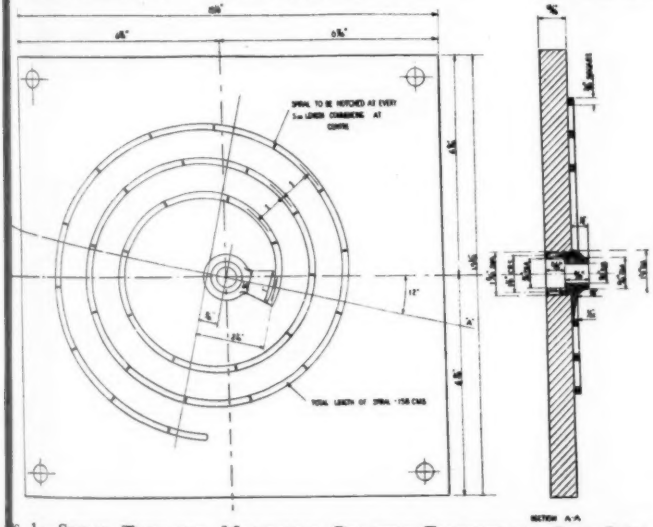


FIG. 1.—SPIRAL TEST FOR MEASURING RELATIVE FLUIDITY OF CAST IRON.

FIG. 2.—INDIVIDUALLY CAST PISTON RINGS.

Fluidity of Cast Iron

in centimetres. This figure is the resultant of a number of factors which, broadly speaking, are:—Temperature; composition; amount of oxide skin; and viscosity and surface tension.

Influence of Temperature

Temperature, both with metals and liquids in general, is undoubtedly the greatest factor affecting the fluidity of cast iron. It is obvious that the nearer the freezing point of the metal, the more difficult it will be for it to flow, so that the greater the amount of superheat on the metal, the higher the fluidity. Whether there is a limit to this statement in the high temperature regions would be difficult to say, but for the range of temperatures produced by ordinary cupola melting, this is certainly true. The temperature of the metal should not be regarded as an absolute indication of good fluidity where this is high, and poor fluidity where it is low, as in certain classes of metal, the fluidity is often drastically altered by small changes in composition.

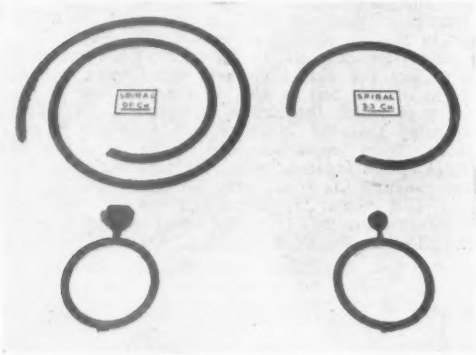


FIG. 3.—TWO RINGS WITH RISERS, CAST WITH IRONS OF DIFFERENT FLUIDITIES, AS SHOWN BY SPIRAL TESTS.

The test previously mentioned is used in connection with the casting of individually cast piston rings (Fig. 2), these castings requiring a high degree of fluidity in the iron used. This is a soft iron of the following approximate composition:—T.C, 3.5 to 3.9; Si, 2.5 to 2.7; Mn, 0.6 to 0.7; S, 0.06; and P, 0.5 to 0.6 per cent. The fluidity of this metal is remarkably sensitive to changes in composition, the temperature of the metal being kept high and as constant as possible throughout the day's run on the cupola. A striking example is thus provided against the fallacy of judging the fluidity of the metal by observing it as it flows from the furnace or ladle. The normal fluidity of the metal as measured by the spiral test is approximately 75 cms., but varies from 50 to 90 cms. This is shown in Fig. 3, which shows two rings with risers, one cast in low fluidity metal and the other in normal fluidity metal. It will be seen that on the left of Fig. 4 the cavity of the mould, including the riser, is completely filled, whereas in the example on the right the ring is cast, but the riser is short run or buttoned. Both these castings were cast at the same temperature, the difference in fluidity being accounted for by difference in composition as follows:—

	Example 1	Example 2
	Per cent.	Per cent.
T.C	3.81	3.92
Si	2.40	2.55
Mn	0.68	0.65
S	0.059	0.062
P	0.56	0.56

The spiral test mould is cast in exactly the same way as the actual ring mould (Fig. 5) immediately after the ladle has left the furnace. The spiral casting is then knocked out and its length measured off directly by means of notches in the casting of 5 cms. intervals.

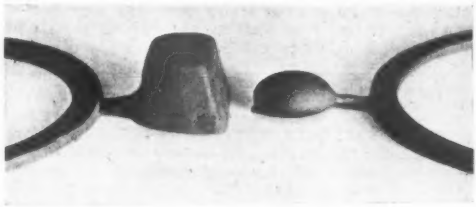


FIG. 4.—DIFFERENCE IN RISERS OBTAINED WITH IRONS OF DIFFERENT FLUIDITY.

This is done by placing it on a brass plate, graduated off up to 140 cms.; this figure by the way has never been reached in practice.

It may be interesting here to note that fluidity on this type of metal is at a minimum when the furnace attains maximum temperature at the beginning of the day's run. At this particular point an analysis on the castings shows the total and graphitic carbon to be high—3.9 to 4.0 per cent.—probably due to the increased melting temperature causing abnormal carbon pickup from the coke, which also may be due to clean melting conditions in the furnace. As the slag volume in the furnace increases, the amount of total and graphitic carbon becomes less and the fluidity increases. It is likely that the fluidity would reach a maximum at the eutectic carbon composition, which for this iron would be 3.4 per cent. carbon. Unfortunately in practice this figure is never reached, since the castings, being small, a chilled casting would

result. Also for the same reason it is not possible to say what would be the fluidity if the total carbon were below 3.4 per cent., but probably the fluidity would begin to decrease again.

Another possible reason for increasing fluidity as

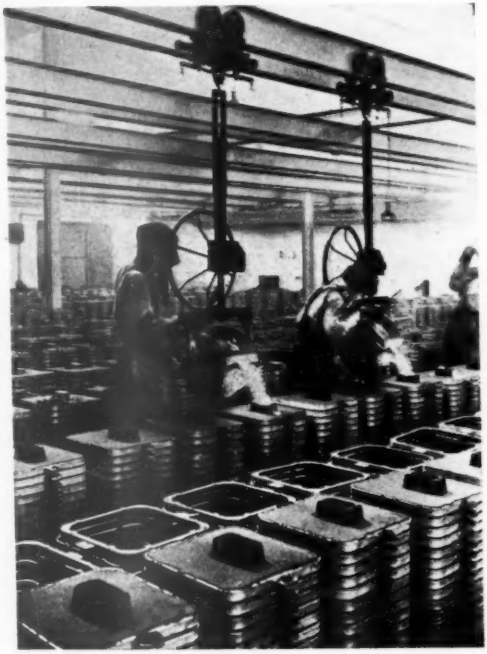


FIG. 5.—CASTING OF SPIRAL TEST MOULD EXACTLY AS ACTUAL RING MOULD.

slag volume increases may be due to the presence of an increasing amount of dissolved oxides in the metal caused by a higher air-to-coke ratio due to gumming up of the coke with slag or to a lowering of the bed-height due to insufficient charge coke. The effect is similar to that produced in steel practice, where the fluidity of the metal is very important and has received considerable attention. In a Paper by Melmoth on "Electric Steel Castings" it is stated in this connection that "Certain charges, fortunately of infrequent occurrence, were found to be of such a sluggish nature, although extremely hot, that it was impossible to handle the material in shanks at all . . . By the addition of a small quantity of iron ore to the slag or of rusty steel scrap to the bath, the slag was made slightly oxidising. The viscous condition was removed. . . ." This may or may not be an influencing factor in cast iron, proof in the form of determination of oxides, etc., in the iron being a difficult undertaking.

Composition

Some remarks have already been made showing the effect of composition on fluidity, more especially with regard to the total carbon content of the iron. From experience it is thought, as has already been suggested, that other factors remaining constant, the fluidity is at a maximum with eutectic carbon composition. Eutectic carbon composition is arrived at by adding the silicon and phosphorus percentages of a given iron, multiplying this figure by 0.3 and subtracting the result from 4.3, which is the eutectic carbon content for pure iron-carbon alloy. Thus, for high-silicon, high-phosphorus irons (total percentage 3.0) maximum fluidity would be attained with fairly low total carbon, *e.g.*, 3.4 per cent. Conversely, low-carbon irons would be more fluid with high silicon and phosphorus. Low-phosphorus hematite irons in which total silicon and phosphorus would be about 1.5 per cent. would have maximum fluidity with about 3.85 per cent. total carbon.

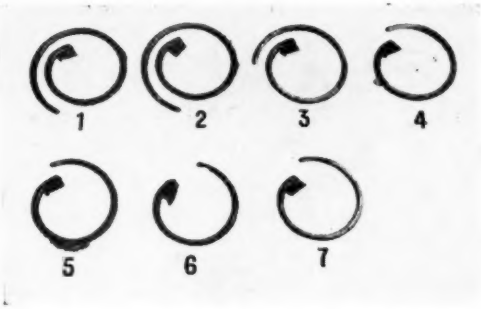


FIG. 6.—SPIRALS OBTAINED IN FIRST SERIES OF TESTS.

From numerous analyses on the small castings previously mentioned, it was found that the state of the carbon had a direct bearing on the fluidity of the metal. Two charges cast into the same size of casting under the same conditions were found to be identical in analysis, including combined carbon, except graphitic carbon. The one low in graphitic carbon had normal fluidity, while the high graphitic carbon had low fluidity. Against this is the well-known fact that low-carbon irons are notoriously sluggish, which seems to be further proof in support of maximum fluidity at eutectic carbon composition. In the case of high-duty irons, which are low-carbon irons with poor fluidity, and where this deficiency cannot be remedied by changes in composition, it must be done by extra superheat.

Though silicon and phosphorus exercise a direct bearing on fluidity, if only by their influence on the

Fluidity of Cast Iron

amount and state of the carbon content, yet it has been suggested that silicon increases fluidity. This statement the author believes only partly true, in so much as it affects the eutectic carbon composition; beyond this a further increase in silicon would probably cause a decrease in fluidity due to causing an increase in graphitic carbon. This theory is borne out in practice. Another fact which leads to the mistaken idea of silicon increasing fluidity is that high silicon irons melted in the cupola attain a greater amount of superheat than low-silicon irons similarly melted. This increase in fluidity, then, is due to extra superheat and not to higher silicon. This fluidity is very often also non-existent, being merely apparent on account of the extra superheat.

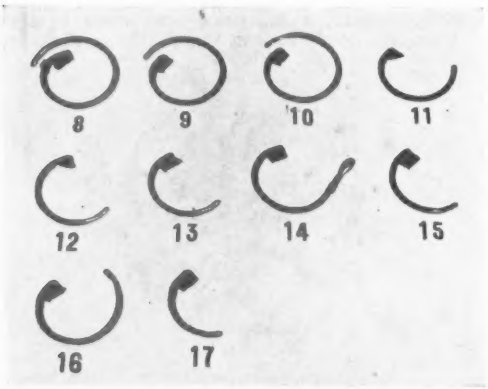


FIG. 7.—SPIRALS OBTAINED IN SECOND SERIES OF TESTS.

Phosphorus and Sulphur

It has been well known for a number of years that high-phosphorus irons were more fluid than irons lower in phosphorus. As a result of this property, stove plates and small-section intricate castings not requiring a high degree of strength were cast in high-phosphorus iron, to ensure a sharp reproduction of the mould. In addition to the reasons already given for this increase in fluidity is the more important one of the lowering of the freezing point of the iron, thus enabling a high-phosphorus iron to flow further before solidifying than a low-phosphorus iron cast at the same temperature. In cupola melting this useful property of high-phosphorus irons is very often not utilised to its full extent, since high-phosphorus irons are easier to melt than those with low phosphorus. As a result, the high-phosphorus metal passes more quickly down the furnace and does not gain as much superheat, so that the fluidity gained by higher phosphorus is lost by lower casting temperature. For this reason the use of small high-phosphorus scrap in the cupola is to be avoided.

The relatively small percentage of sulphur usually found in cast iron will not greatly affect the resultant fluidity of the cast iron, but it has been said that sulphur decreases fluidity. In view of the other bad qualities attributed to sulphur, this is probably the case, although it will probably be possible to offset this by a proper sulphur-manganese balance. It has not been possible to say from experience just what effect sulphur and manganese have on fluidity, since both these elements are kept more or less constant

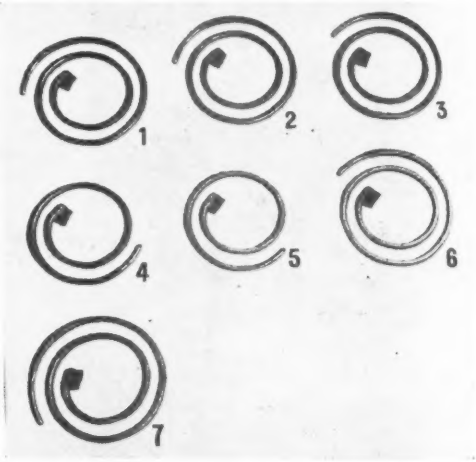


FIG. 8.—SPIRALS OBTAINED IN THIRD SERIES OF TESTS.

for obvious reasons. The sulphur being as low as possible—0.1 per cent. maximum and manganese 0.6 to 1.0 per cent. in the irons under observation.

Manganese and Fluidity

In the case of manganese, it was noticed that this element seemed to increase the trouble already shown, namely, short-run risers, in the small individually cast piston rings. For this reason it was never allowed to exceed 0.7 per cent. Against this is the fact that manganese has a pronounced effect on the oxide-skin formed on the surface of the metal. A high-manganese iron (0.9 to 1.2 per cent.) will exhibit a very lively surface showing "flowering," as against the steady, thickly skinned surface of low-manganese irons. Also, certain high-manganese steels show a very marked increase in fluidity over the ordinary carbon steels used in steelfoundry practice.

Oxide Skin

The amount of oxide skin on the surface of the metal in the ladle is a good indication of the resultant fluidity of the metal. In many cases this is the only indication that the ordinary foundryman has, where temperatures are not taken and where the same class of metal is run every day. The action of this oxide skin is best seen by observation of metal like aluminium, where the oxide film on the surface of the metal is so tenacious that the metal underneath has literally to force its way through, when pouring is commenced. It can also be seen by a consideration of the flow of the metal in the spiral mould.

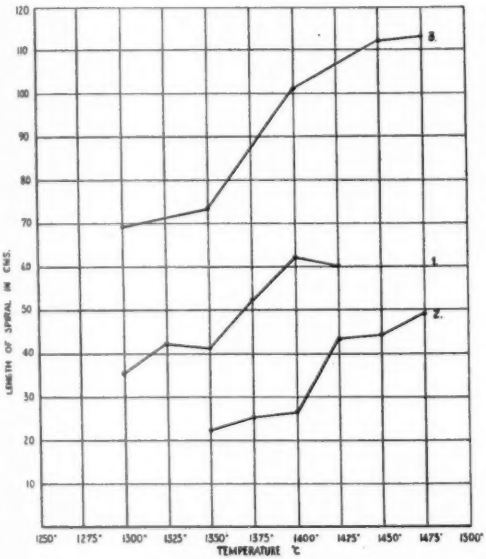


FIG. 9.—GRAPH SHOWING RELATIVE FLUIDITIES OF THREE MAIN IRONS INVESTIGATED.

If the flow is recorded as a series of small individual thrusts, the metal can be visualised as having to force its way at each thrust, through a layer of oxide skin which increases in thickness as the metal begins to set, till a point is reached when this film is so thick that this becomes impossible. This theory is substantiated by the fact that many spirals when examined are found to have a small bead of metal at the end, which has forced its way through the final oxide skin and then solidified. It is also interesting to note that many spirals have their corners rounded, and even become flattened towards the end of the spiral. The extent of this rounding or flattening seems to depend on the composition of the metal, being more noticeable on low carbon irons.

Viscosity

This has, of course, a direct bearing on fluidity, but since it has not been fully explored, for the purpose of this Paper, together with surface tension, it has been regarded as a constant.

Having outlined the factors influencing the fluidity of cast iron as observed from practical experience, it was thought it would be interesting to try and justify these by experiment. Several difficulties arose, however, the first and main one being the enormous number of variables. Then came that of the necessity for accurate temperature measurement. This could not be done with an optical pyrometer, which was the only instrument available, so that the temperatures given later cannot be regarded as absolute, but merely comparative. With regard to composition, each of the main elements, carbon, silicon, sulphur, phosphorus and manganese, was open to investigation at various percentages, the remaining four elements remaining constant. In addition to these were the alloying metals, nickel, chromium, molybdenum, etc., but such a large quantity of different compositions were required that it was decided to narrow these down to three compositions:—(1) A low silicon, medium carbon, medium phosphorus iron, such as is used for fairly large castings; (2) a low carbon iron such as is used for high-duty castings, and (3) a normal foundry iron, high in phosphorus, such as is used for light jobbing work, where no particular strength is called for, and fluidity is very important.

The results of the following experiments, therefore, are not meant to be regarded as absolute values, but are merely to show the relative fluidities of three widely different compositions at different temperatures.

The form of fluidity test used was a modification of the spiral test already described. The original spiral mould was first tried, but with some of the irons in use, particularly the low-carbon ones, it was found to give very low results. Another pattern was therefore made, having the sections increased to $\frac{3}{32}$ in., the ingate to $\frac{7}{32}$ in. tapering to $\frac{1}{4}$ in., where it entered the spiral, and the downgate to $\frac{1}{8}$ in., the other dimensions remaining the same. For the sake of convenience in moulding, the head was also shortened to 3 in. from 4½ in.

A 150 lbs. melt of the first iron was made in a crucible furnace, the charge was 100 per cent. scrap. The resultant metal gave the following analysis:—T.C, 3.14 per cent.; Si, 1.17; Mn, 0.51; S, 0.125; P, 0.34; Ni, 0.16, and Cr, 0.23 per cent. The small percentages of nickel and chromium were incidental and not intended constituents. Spirals were then cast from this metal, which was round about 1,500 deg. C. at 25 deg. intervals from 1,475 deg. C. to 1,300 deg. C. The method of doing this was to take about 5 lbs. of metal in a sample spoon holding from 8 to 10 lbs., set the optical pyrometer at the temperature required, sight it on the surface of the metal in the spoon, allow the metal to cool to the required temperature, then quickly cast the spiral. Fig. 6 and the table overleaf show the results.

Fluidity of Cast Iron

Then 1 lb. of ferro-silicon in lump form was added to the remaining metal, and another spiral was cast at 1,400 deg. C., the length of which was 40 cms. This

Spiral No.	Temp. Deg. C.	Length Cms.
—	1,475	Bad mould
—	1,450	" "
1	1,425	60
2	1,400	62
3	1,375	52
4	1,350	41
5	1,325	42
6	1,300	35

is 22 cms. less than the spiral cast without silicon at the same temperature. The analysis of this iron was now as follows:—T.C, 3.14; Si, 2.05; Mn, 0.66; S, 0.106; P, 0.30; Ni, 0.16, and Cr. 0.23 per cent.

Using this iron as a base, an addition was made of 12¼ lbs. of refined pig-iron (approximately 10 per cent.), and 12½ lbs. of steel scrap. The analysis now became:—T.C, 2.75; Si, 2.10; Mn, 0.63; S, 0.107; P, 0.40; Ni, 0.20, and Cr, 0.21 per cent. The temperature was again raised to 1,500 deg. C., and a set of spirals cast exactly as before with the results shown in Fig. 7 and as below:—

Spiral No.	Temp. Deg. C.	Length Cms.
8	1,475	49
9	1,450	44
10	1,425	43
11	1,400	26
12	1,375	25
13	1,350	22
—	1,325	Bad moulds
—	1,300	" "

Then ½ lb. of lump ferro-silicon was added and a spiral cast at 1,425 deg. C., but the ferro-silicon must not have dissolved, since on analysis the silicon was only 0.12 per cent. higher (2.22 per cent.), and anyway the spiral as will be seen from Fig. 7 is useless on account of a bad mould.

Next ½ lb. of nickel shot was added to the metal, this addition made the total percentage of nickel 0.79 per cent. A spiral was cast at 1,425 deg. C., the length of which was 20 cms. It was thought that this shortening of 23 cms. compared with the spiral of 43 cms. in the almost nickel-free iron, may be due to the fact that it was poured by a different man, who probably did not get the metal into the mould quickly enough. As there was a shortage of moulds, however, it was decided to continue, so a further ½ lb. of nickel shot was added which now brought the total percentage to 1.42 per cent. Another spiral was cast at 1,425 deg. C. by the usual man, but this spiral was only 31 cms. compared with 43 cms. for 0.2 per cent. nickel. Although no definite conclusions as to the behaviour of nickel can be made from these two results, they seem to indicate that even if nickel does not actually reduce the fluidity of cast iron, it certainly does not cause any marked increase, as is sometimes claimed.

The remaining metal was now poured from the furnace into a shank containing ¼ lb. of powdered soda-ash, and another spiral was cast. This, however, was faulty, being only 17 cms. in length, as it was not found possible completely to clear the surface of slag, and some of it reached the mould. The analysis of the metal was:—T.C, 2.75; Si, 2.22; Mn, 0.63; S, 0.079, and P, 0.42 per cent.

Another 150 lbs. melt was now made, again with 100 per cent. scrap. A spiral was cast at 1,475 deg. C., the length of which was 102 cms.; a phosphorus estimation was made on this metal, and was 0.51 per cent. phosphorus. To this metal was then added 1½ lbs. of ferro-phosphorus, and a series of spirals was cast at various temperatures as before. The iron was of the following composition:—T.C, 3.36; Si, 2.45; Mn, 0.70; S, 0.076; P, 0.74; Ni, trace, and Cr, 0.17 per cent.

The results of these spirals were as shown in Fig. 8, and tabulated below.

Spiral No.	Temp. Deg. C.	Length Cms.
2	1,475	113
3	1,450	112
—	1,425	Bad mould
4	1,400	101
5	1,350	73
6	1,300	69

On account of a shortage of moulds, the spirals corresponding to 1,375 and 1,325 deg. C. had to be omitted. A further 1½ lbs. of ferro-phosphorus was added to the remaining metal and a spiral cast at 1,450 deg. C., the length of which was 120 cms. This metal had 1.25 per cent. phosphorus.

Although these experiments were very limited, they substantiate the remarks already made regarding the influence of temperature and composition on the fluidity of cast iron.

A graph (Fig. 9) was made to show the relative fluidity of the three main irons investigated; this shows that to obtain the same fluidity from irons (1) and (2) it would be necessary to give iron No. 2 approximately 100 deg. C. extra superheat. Also, that iron No. 2 cast at 1,475 deg. C. is not as fluid as iron No. 3 cast at 1,300 deg. C. These results, although not intended to be regarded as absolute values, show the very wide variation existing between irons of different compositions. It is also interesting to note that the difference in fluidity due to temperature variation does not follow a straight line on the graph, but falls off very rapidly in the case of iron No. 2, becoming steadier in iron No. 1 and still steadier in iron No. 3, in which case it occurs over a range of 50 deg. C.

This peculiarity may be due to a sudden lessening of the fluidity due to the formation of primary austenite particles in the liquid metal, as this occurs about the required temperature on the equilibrium diagram. Another explanation is that, owing to waiting for the metal to cool in the sample spoon, a heavier oxide film is formed on the metal cast in the lower temperature range.

In conclusion, the author thanked the directors of Messrs. Hepworth & Grandage for their permission to publish facts relating to the production of single-cast rings, and also for their permission to carry out the experimental work.

DISCUSSION

MR. NICHOLS asked whether the author instituted sand control in his spiral tests?

MR. BURGESS replied that the sand used was controlled at about 3.5 per cent. moisture, 10 lbs. bond strength, and 32 permeability number. Moreover the moulds were roughly of the same density.

The BRANCH-PRESIDENT (Mr. F. Oldershaw) asked were these moulds made in green sand or dry sand? He asked because on the lantern slides he noticed certain places seemed a little thickened, and he wondered whether it would be better to standardise on the dry sand mould to avoid any swelling owing to pressure?

MR. BURGESS said that in America tests were made as to whether they should be in dry sand or green sand, and the conclusion was reached that it was immaterial. The swellings noted in the illustrations were caused by photographic technique.

MR. H. FORREST, supplementing the author's observations in regard to the fluidity test, said the moulds for the tests had been made from a pattern plate fitted to a moulding machine. Each day two or three stacks were made, and the process was quite standardised. The type of sand used was exactly the same as the process sand, and the moisture and degree of running did not vary.

Excessive Blast

The CHAIRMAN asked whether the author could explain more fully how excessive blast and oxygen affected the fluidity?

MR. BURGESS said it would induce a definite decrease in fluidity.

The CHAIRMAN added that excessive blast would lower the carbon and consequently reduce the fluidity. With 3.3 to 3.4 per cent. carbon there should be no sluggishness, and excessive oxygen had an influence on fluidity owing to the wetting propensities in the surface tension of the smaller globules. He agreed there was no means of checking it because when it was solidified the effect was gone.

MR. FORREST pointed out that it was often noticed in general foundry practice that where there was an excessive amount of air going into the cupola, the iron went off condition very quickly and lost its good casting properties. It was definitely attributable to lack of fluidity. The reason was, he thought, the high oxygen content of the iron. It was a fact that irons were influenced by the amount of oxides present, and probably that would be borne out by the experience of most foundrymen when they made a particular batch from certain types of pig-iron which were found to give poor results. He believed that was related to the melting practice of the particular iron, and was very often confined to certain refined irons, due to the expedients used in some cases to obtain these carbon refined irons.

The CHAIRMAN, agreeing, said the metallurgist would insist it was impossible to have more than a certain amount of excess oxide in an iron because there were enough elements to nullify it, but still founders do sometimes get an iron which has something about it which one cannot explain, and he thought it was quite possible to have that difficulty in the liquid state and yet not be able to trace it in the solid iron.

MR. FORREST pointed out he was not referring to iron oxide. He thought it was the silica which was oxidised, and low fluidity results. Possibly it was due to a formation of silicates in the melt rather than to oxidation of the iron.

Standardised Conditions

MR. OLDERSHAW (Halifax) asked whether there was a definite head pressure on the bush—was it of the standard pressure type variety? He asked this because he felt a point which influenced fluidity was that of the height from which it was poured. Did the author vary his pouring or was it constant?

MR. BURGESS said he used a ladle bowl set about 1 in. above the bush, and it was poured as quickly as possible so that there were no temperature variations.

MR. FORREST added that the spiral test was carried out very quickly. It was knocked out before the bush was set and a quick estimation of conditions was established.

MR. THORNTON referred to the fact that all the examples given were pot-melted, and asked whether it made any difference if some of them had been cupola melted.

MR. BURGESS said that probably there would be a material increase in the fluidity.

Steel Problems

MR. W. PARKER said he had lately been dealing with a problem involving the fluidity of steel. The steels had been the same temperature and he should imagine that, if they were to run like the spiral tests, the difficulty might be overcome. In his work the sand had reached to as low as 2 per cent. moisture, and a permeability of about 150, but they had to increase the latter to about 200. Then, by keeping the moisture low and bond strength high, the metal ran perfectly, and yielded very clean castings. It seemed, he thought, to suggest that the permeability figure helped with fluidity.

The CHAIRMAN asked whether there was an air vent in spiral tests, or did it terminate in a dead end?

The PRESIDENT: If there was no vent, then there may be a "jumping" effect. Some form of outlet would help in the formation of a better spiral.

Fluidity of Cast Iron

MR. FORREST said there was no vent, as he required to test every charge and establish the same conditions for proper control. No special sand was purchased. It was virtually a facing sand and there was no coal dust incorporated.

Influence of Aluminium on Fluidity

The BRANCH-PRESIDENT then inquired as to whether any aluminium was used to help in extending fluidity.

MR. BURGESS said that aluminium would be definitely harmful to the metal, as it tended to lower rather than increase the fluidity unless it was highly oxidised.

The CHAIRMAN thought an addition of about 2 ozs. of aluminium per ton had a beneficial influence on fluidity. The aluminium was changed to alumina, and he had found it did improve fluidity.

MR. FORREST said, personally, he would not like to advise anybody to use aluminium for this purpose. He recalled a sample of a "cure-all" specific which he was once persuaded to use, and he obtained a cast ring literally full of holes. The material was part aluminium dust and part silicon, and ever since then he became convinced that aluminium was unsuitable except for the bigger type of castings.

The CHAIRMAN agreed that aluminium was a potential cause of trouble, but he thought it did improve fluidity, and it was a case of using it, if at all, with all factors in mind.

High Manganese and Pinholing

MR. FORREST said a remarkable thing occurred when the manganese content was high. On one occasion, he recalled, he increased the manganese content, which improved the casting, but when it was increased still further, pinholing resulted. There was evidently a definite point of relationship between manganese and silicon at which there was this very fine pinholing, and it was necessary to avoid reaching that point.

MR. BURGESS gave another illustration, in the case of pistons, of faults due to lack of fluidity, and he showed by blackboard sketches a shrink-hole and a small "bead" or pellet of iron which, he said, was found to be due not to the metal, but probably to poor fluidity.

The CHAIRMAN pointed out that such "beads" could often be attributed to the phosphide eutectic in the metal being squeezed into that pellet formation.

MR. BURGESS said that in the case cited a very low phosphorus iron was used, and it was felt that it was quite definitely a fault related to insufficient fluidity.

MR. THORNTON favoured the theory that the beading was due to the carbon being too low in relation to the low phosphorus. Thus it became a question of composition rather than fluidity.

MR. NICHOLS said he agreed with the author's view that it was most likely due to lack of fluidity. Even if the metal was slightly oxidised on the skin, a "bead" of iron can appear.

MR. BURGESS pointed out that the "bead" was not always there.

MR. FORREST said that, with a higher domestic scrap percentage in the charge, the carbon content was lowered and the eutectic composition was approached, resulting in trouble. If there was a progressive decrease in the carbon content due to dilution, the eutectic composition is finally approached, and then trouble ensued. Experience had shown how to avoid reaching that point.

MR. BURGESS said he had carried out some fluidity tests using the centrifugal method of casting, and found a cavity or "dimple" on the outside of the ring when the fluidity of the metal was low, but it disappeared when fluidity was increased.

MR. FORREST said that certain brands of pig-iron appeared to cause more trouble in that respect than others, but it was not necessarily so. One cause was holding the metal too long in the cupola. Although no actual carbon pick-up occurred, it did have an influence on the "life" of the metal.

MR. BURGESS pointed out that the fluidity might not be the cause of these defects, but, if it was low, trouble was certain. There was no doubt that there was a definite falling off in fluidity under war conditions, quite probably due in some measure to reasons of this kind.

Vote of Thanks

Thanks to Mr. Burgess—and also to Mr. Forrest, who had been associated with the tests—were carried unanimously, on the motion of MR. TURNER, seconded by MR. SQUIRES.

MR. BURGESS, in responding, voiced his thanks to Mr. Jones and Mr. Bolton, two members of the Branch from the same firm, for assistance they had given in the work involved in preparation of the Paper.

Plumbers' Solder.—The British Standards Institution has issued a memorandum No. 3, January, 1943, to B.S. 219, Soft Solders PD 76. The recommendations contained in this memorandum have been approved by the Non-Ferrous Metals Control, and they will be used as a guide in the granting of licences for the purchase of tin. The weight of solder customarily used for making wiped joints is about 8 ozs. per joint in ½-in. lead pipe, but it has been established that by other well-known methods satisfactory joints can be made using less than one-fifth of an oz. Hydraulic and tensile tests have proved them stronger than the lead pipe, and the time taken to make them is, in general, less than that required for a wiped joint. It is therefore recommended as a war-time emergency measure that the wiped joint should not be used unless there is some special consideration which makes such a joint indispensable. Copies of this memorandum are obtainable from the Institution, 28, Victoria Street, London, S.W.1, free of charge, on receipt of a stamped directed envelope.

— SAVE MORE PAPER —

BRIQUETTING OF TURNINGS AND BORINGS

By W. A. PHAIR*

The economic disposal of the very large volumes of steel turnings and cast-iron borings is a problem which confronts every company engaged on extensive armament production. Difficulty in handling these materials because of their bulk and resilience, coupled with their strange behaviour when introduced into a melting furnace, have frequently rendered them unacceptable as good melting scrap, unless they have undergone some form of pretreatment or conditioning. So far, nothing in the nature of a standard treatment has been evolved, probably due to the widely varying nature of the raw material, although the consensus of opinion seems to indicate that the only way satisfactorily to deal with the turnings is to subject them to some form of bundling or packaging.

In order to find out what was being done in the United States regarding this matter, the author has surveyed practice at twelve different plants, and has collected details of melting losses, die size, briquette weight and the amount of briquettes which can be used to a charge. At one time, he points out, the war agencies were seriously considering the establishment of regional briquetting plants to cope with the flow of turnings and borings expected. In the meantime, numerous individual plants have installed units since the emergency was declared in 1940, and the backlog of orders for such equipment is tremendous.

Of the 12 plants participating in the survey, six briquetted both cast iron and steel, while six handled cast iron only. The die sizes, briquette size, weight and production are given in Table I. Briquetting machines are manufactured in various capacities. The output data given in Table I do not necessarily represent the maximum capacity of each unit. Various considerations, such as the amount of material available, may exist in individual plants that do not permit utilising the full capacity of a press. On the other hand, it is possible to force a press to produce in excess of its rated capacity. The figures given in Table I indicate only what a given plant is actually doing. These figures should not be construed as indicating capacity ratings in themselves.

* Western Editor, "The Iron Age."

Sizes of Die

The plants participating in the survey were asked if they had experimented with other die sizes, and, if so, why had they standardised on the size being used. It appears in a majority of cases that the recommendations of the machine maker have given the most satisfactory results. In one instance it was reported that experimenting resulted in some costly lessons as ram freezing, chipping of the die, etc. In several cases the same die is used on both cast iron and steel, although the briquette size is not always the same, due to the different compressing characteristics of the two metals.

One plant reported starting with a 2¼-in. briquette, but going later to 3 in. to increase production. This plant is using a small machine, but with a 3-in. die is able to handle 4 tons of steel or 8 tons of iron per 8-hr. shift.

There was general agreement that the melting loss encountered with briquettes is around 5 per cent., the exact average being 5.3 per cent. The melting losses are given in Table II. Here again a lack of standardisation in reporting makes it difficult to compare these losses. The circumstances surrounding the one loss of 10 per cent. are somewhat unusual and are not those met in ordinary practice. Too, experience is also a factor in the melting losses. Plants that have been using briquettes for many years and who have made an intensive study of their action in the cupola are usually able to bring the loss below 5 per

TABLE I.—*Briquetting Practice in Various Plants*

Plant.	Output, tons per 8 hrs. per machine.		Briquette size.*		Weight, lbs.		Density, per cent.	
	Cast iron.	Steel.	Cast iron.	Steel.	Cast iron.	Steel.	Cast iron.	Steel.
A	10 to 12**	—	4½ by 3½	4½ by 2½	9.8	6.8	—	—
B	16**	—	4½ „ 2½	4½ „ 3½	6	6	80	65
C	8	4	3 (dia.)	3 (dia.)	2¼	1⅞	—	—
D	20	—	4½ by 3	—	9 lb. 1 oz.	—	—	—
E	22	—	4⅜ „ 4	—	11	—	78	—
F	20 to 25	10 to 14	—	—	8 to 9	4 to 5	—	—
G	35**	—	4 „ 3½	7 by 3½	8.5	22	—	—
H	30	20	5 (dia.)	5 (dia.)	14 to 15	9 to 10	—	—
I	20	—	4 (dia.)	—	10	—	80	—
J	18	15	3 by 3	4 by 1½	4	3	85	75
K	7	—	2¾ „ 2½	—	3	—	80 to 90	—
L	20	—	4¼ (dia.)	—	10.5	—	78	—

* First dimension is diameter. ** Cast iron and steel.

Briquetting of Turnings

cent., often in the neighbourhood of 3 or 4 per cent.

Another interesting phase of the survey was the wide variation in the amount of briquettes used in each charge. While the types of casting being produced are the determining factor in this ratio, it was noticeable that in several cases plants making practically the same type of iron differed widely in the quantity of briquettes used. It is quite possible the

TABLE II.—*Melting Loss Using Briquettes.*

Plant.	Per cent. loss.	Plant.	Per cent. loss.
A	5 to 6	G	5
B	4 to 6	H	*
C	5	I	3
D	3 to 5	J	10
E	5	K	7
F	4	L	*
	Average 5.3		

* Not reported.

factor of supply, which was not accounted for in the survey, was responsible for the difference. Table III shows the percentage of briquettes used per charge.

Percentage of Briquettes Used

The question of what is the maximum percentage of briquettes which can be used with a charge is again dependent largely upon the type of casting poured. Heats consisting of 100 per cent. briquettes have been cast experimentally, but, according to the survey, it appears that most operators feel that 50 per cent. is probably the economic maximum under to-day's price conditions. In connection with this problem, it is interesting to note that one machine tool casting maker commented that 50 to 60 per cent. cast-iron briquettes could be used to make high-grade machine-tool castings and that as high as 50 per cent. steel briquettes may be used, but the carbon will be low.

Some of the typical percentages used are as follow:

For both high-duty and soft iron, 30 per cent. steel and 30 per cent. cast-iron briquettes. A plant running cylinder iron reported having used as high as 25 per cent. cast-iron briquettes. A maker of alloyed brake-drum iron, which is duplexed in an electric furnace, uses the following charge: Cast-iron briquettes, 50 per cent.; pig-iron, 25 per cent.; returns, 10 per cent.; alloys, 1 per cent.

Another producer of piston and cylinder iron regularly uses 10 to 20 per cent. cast iron and 10 per cent. steel briquettes. A plant running 20-ton tensile iron states that it regularly uses 10 per cent. cast iron and 8 per cent. steel briquettes, although as high as 35 per cent. briquettes have been used.

On the question of segregation of borings and turnings by analysis, it appears that much work is yet to be done, although several plants are already separating the nickel-containing material from plain iron and steel. In another instance, material is separated into two silicon classes: 1.90 per cent. and over, and 1.90 per cent. and under. Of course, in some plants, running only one type of iron or steel, segregation is not necessary.

One plant stated that precautions must be taken to bring down high sulphur content. This was being accomplished, it was stated, by use of a fore hearth and 4 lbs. of soda ash, or Purite, to a ton of metal. This plant uses cast-iron briquettes only, some of which contain cutting compound. This compound is largely removed by draining.

Cost Considerations

In answer to the question "did briquetting reduce your spout metal cost?" all plants in the survey reported favourably. While many were unable to supply estimates as to the extent of the reduction, probably due to the fact that this is dependent upon the market price of the borings, one plant estimated the savings at 6 to 12 per cent., another at 8 per cent., and a third at 2 per cent.

TABLE III.—*Per Cent. Briquettes Used in Each Charge.*

Plant	Cast iron.	Steel.	Castings made.
A	50	20 to 40	Machine tool.
B	15	Varies	Miscellaneous.
C	30	30	High duty and soft iron.
D	10 to 20	—	Cylinder iron.
E	50	—	Alloy iron, duplex.
F	10 to 20	10	In electric furnace; piston and cylinder iron.
G	10	8	40,000 lb. tensile iron.
H	15	15	Soft iron.
I	10	—	30,000 lb. tensile iron.
J	20	10	General grey iron.
K	4	—	Cast iron, pressure.
L	20	—	Cylinder iron.

Probably the most interesting phase of the survey was the wide range of answers as to what were the advantages of using briquettes as compared with ordinary scrap. The following are typical comments: Lower cost of scrap; when using home-produced borings, analysis of melt can be more closely controlled; charging practice simplified, due to uniform size of briquettes; simplification of storage problem; assured scrap supply; uniformity of size; assurance of supplies under present conditions; lower metal cost of spout; better microstructure; more compact metal charges; and easier to handle.

A general reticence was shown towards divulging cost figures. The cost was widely affected by the degree to which the capacity of the machine was utilised; thus a machine working 24 hrs. a day has a much lower cost per ton than a machine working only an 8-hr. shift, yet the machine working only 8 hrs. may be more than paying for itself. It is hoped at a later date to devise a means of establishing costs on a common basis.

RAPID QUENCHING FOR LIGHT METALS

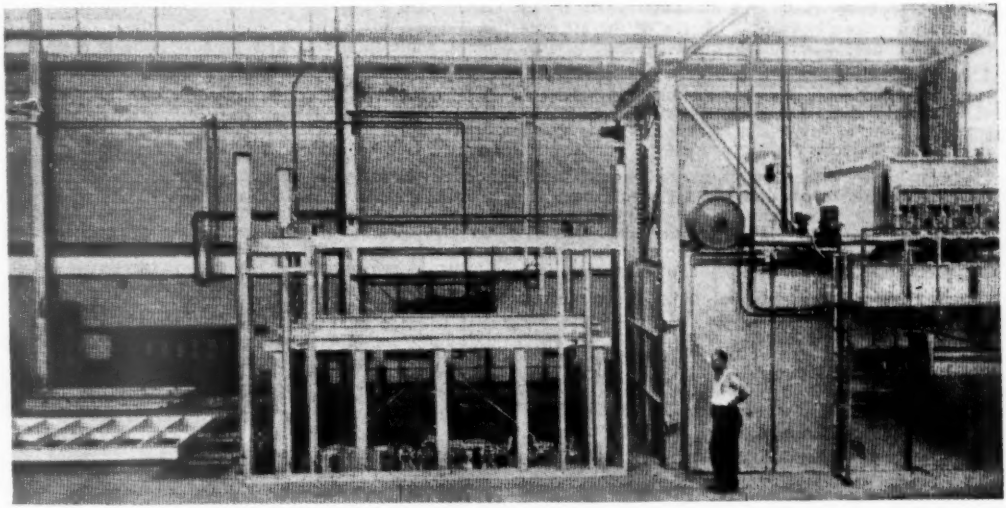
A special quenching system which permits withdrawing and quenching 4 tons of aluminium castings in 25 secs. is one of the features of a new aluminium-alloy heat-treating furnace recently installed in an Ohio plant. Need for greatly increased production of aluminium castings prompted the installation, according to plant officials.

This unusual material handling system enables an operator to do in 5 mins. an operation which formerly required from 2 to 3 hrs. In addition, the fully-charged furnace may be kept in continuous operation, handling capacity loads in the chamber, then quenching each big load as a unit in a matter of seconds. Reloading immediately follows. The unit, which is believed to be the first of its kind in America, was designed and installed by the Despatch Oven Company, Minneapolis. Uniformity of ± 2 deg. C. is claimed for the furnace interior. Magnesium castings may also be handled by this unit.

In operation, two load platforms are used, the cargo of one being heat-treated, while the load which preceded it is being quenched and unloaded. As a processed load is pulled from the furnace, it is quickly dropped by elevator into the quench bath, as shown in the illustration below. Rollers on top of the elevator cage then form a bridge over which the waiting load platform (shown to the left) with its raw charge, is pushed into the furnace.

When the unit was first put into operation, about 30 secs. were required to pull the load and quench it. It is expected that after some experience, an operator can handle the entire process in 20 secs.

The unit as installed in the Ohio plant has three divisions: The loading section, the quench section and the furnace. Each of these bears a series of rollers, carefully aligned, which form a smooth track over which the loaded platforms can easily be pulled by an air-operated winch.



NEW QUENCHING AND HEAT TREATING EQUIPMENT FOR ALUMINIUM CASTINGS.

A load of aluminium castings which have just been removed from the heat-treating furnace is being lowered into the quench tank. As soon as this charge is completely immersed in the quench, rollers mounted on top of the cage will be in alignment with rollers under the car to the left of the cage and also with rollers leading into the furnace. Thus a new charge may be pushed into the oven while one charge is being quenched, greatly reducing the down time of the furnace.

The loading section is of heavy structural steel, capable of supporting the load platform, each of which may carry a gross charge of nearly 5 tons. The upper surface of the loading section carries a series of steel rollers. The quench section (17 ft. long, 8½ ft. wide and 11 ft. high) includes a steel elevator cage with air hoist equipment, a tank and suitable drain and overflow. Two Eclipse burners heat the bath, and automatic temperature control is provided.

Rollers in the quench section are mounted on top of the elevator cage and also on the bottom. Thus there is always an "open track" from loading section

(*Concluded on page* 208.)

CONTINENTAL NOTES

Badische Wolframerz G.m.b.H., Söllingen, which treats tungsten ores and manufactures ferro-alloys, has raised its capital to 1,000,000 Rmk.

Union Nationale de la Construction Metallurgique, Vichy, has been formed to deal in iron and steel and to undertake engineering work in France and the French colonies.

French steel foundries have formed the Association française des aciéries de moulage, to organise production and control selling arrangements throughout the steel castings industry.

Production of ferro-silicon, 9 to 14 per cent. Si, used for grey-iron, steel and malleable castings, is limited on a quota basis by a decree of the Reichsstelle Eisen und Metalle and Reichsvereinigung Eisen.

Lanz-Perlit Research Volume.—The research institute of H. Lanz A.G., Mannheim, recently issued the first volume of their research memoirs. The volume contains 392 pp. of reprints of the Papers of K. Sipp and his collaborators issued between 1912-1941.

Under a decree made last January, German foundries do not have to pass on to buyers economies in production up to 1 per cent. of the selling price, or 50 Rmk. per casting. All larger savings must be passed on to the customer. This decree applies particularly to armament and military equipment castings.

Societa Metallurgica Italiana, non-ferrous metal producers, made a net profit of 21.1 million lire in 1941-42, against 21.7 million in the previous financial year, after taxes of 42.7 million lire against 22.22 million. An unchanged dividend of 14 per cent. has been declared on the 90 million lire capital. Some sections of the plant have been modernised.

Taxes in France have again been raised substantially to cover the heavy expenditure provided under the 1943 budget, which totals 102,000 million fcs. against 80,000 million for 1942. These figures do not include the heavy cost of the German army of occupation, which is advanced by the Banque de France. Among the tax increases is an advance in the wage and salary tax, which is a heavy burden on industry, from 8 per cent. to 16 per cent. The 1942 tax also carried a 5 per cent. supertax, which has now been apparently consolidated.

The scrap situation in Sweden was reported early in January to be getting very serious, so much so that a new decree is expected in order to improve the collection of scrap and its distribution to iron and steel works. Distribution quotas are to be reviewed and a scrap reserve will be created. At the moment, consumers are working on a hand-to-mouth basis. From the works, it is reported that rolling mills registered a record output in 1942. Imports of merchant iron were on a better scale, and exports were reduced, thus providing more material for the home market. Nevertheless, stocks of pig-iron, castings and scrap at works and in merchants' hands have shown a downward trend.

IRON AND STEEL PROGRESS IN SOUTH AFRICA

The war has made heavy demands upon the South African iron and steel industry, existing capacity being barely able to meet the growing requirements. In this connection a third blast furnace is now under construction by the South African Iron and Steel Industrial Corporation, practically all of the essential materials and manufactures being provided from within the Union. The erection of another blast furnace involves a new coke-oven and additions to the by-products plant. Some 45 Becker top-charged ovens are being installed, providing with continuous operation some 350,000 tons of coke per annum. Acid-Bessemer equipment, consisting of two 25-ton converters and a 750-ton mixer, is being added to the steel-making plant, while the heavy steel foundry is being extended. Extensions are being made to the buildings housing the rail mill and the sheet mill, and the capacity of the electric power plant is being increased. A new cogging mill is being laid down.

Looking to the future, the erection of a new steel plant in the Vereeniging district is contemplated, the site having already been acquired. This has been chosen partly on account of the favourable location for raw materials and the suitability of the terrain for a large works. Work has already commenced, although some years are expected to elapse before the works are completed. A start is being made with the installation of a heavy plate mill capable of an annual output of some 100,000 tons of material up to 6 ft. wide by 1 in. This unit may form later on part of a continuous mill for rolling sheets and tinplate. Until the other necessary plant is erected at the new works, this mill will be supplied with slabs rolled in the new cogging mill at Iscor Works. Ultimately it is proposed to build a blast furnace, coke ovens and steel plant on the new site. Thus the Union will become more and more independent of imported steel. The same may be said of many engineering products which are now being made in the Pretoria district and elsewhere.

RAPID QUENCHING FOR LIGHT METALS

(*Concluded from page* 207.)

to furnace chamber; this is true whether cage is raised to floor level or immersed in quench bath. The furnace is of the radiant tube convection type with indirect gas heating. No combustion gases enter the work chamber, and all types of aluminium alloys (including Nos. 355 and 356) can be heat-treated.

The heat flow is both vertical and horizontal. Heat enters through ducts on the sides of the furnace, while a recirculating duct is in the furnace ceiling. The floor carries the steel rollers which are aligned with similar rollers on the elevator cage and the loading section. Since the installation of this new unit, plant officials report much faster casting treatment, a noticeable saving in heat through improved recirculation and a smoother operating cycle.—"The Iron Age."

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"ACME"—Mowing machines and hand tools. QUALCAST, LIMITED, Victory Road, Derby.

"BULL DOG"—Metal clips. BRITISH COLEMANOID, LIMITED, 67, Watling Street, London, E.C.4.

"BEQWI"—Lock nuts. BEQWI, LIMITED, Westralia House, 66, Gresham Street, London, E.C.2.

"ROMAC"—Hand tools. ROMAC INDUSTRIES, LIMITED, Romac Works, The Hyde, Hendon, London, N.W.9.

"WONTOOLS" (and athlete device)—Machine tools. WINTOOLS, LIMITED, Audrey House, Ely Place, London, E.C.1.

"AAPHOS"—Metals. ANTI-ATTRITION METAL COMPANY, LIMITED, Glengall Works, Glengall Road, London, S.E.15.

"PACERA"—Machine tools. W. J. MEDDINGS, LIMITED, Kingsley Works, 535-538, Ipswich Road, Slough, Bucks.

"BROCKHOUSE KWIKFIKS"—Trailers for motor vehicles and couplings. J. BROCKHOUSE & COMPANY, LIMITED, Staffs.

"BESTOFLEX"—Asbestos, etc. TURNER BROS. ASBESTOS COMPANY, LIMITED, Clod Mills, Spotland, Rochdale, Lancs.

"LATEM"—Radiators, stoves, etc. BRADFORD METAL CASE COMPANY, LIMITED, Eastwood Works, Hall Lane, Bradford, Yorks.

"BONDERIZED" and "PARKERIZED"—Metal heels, etc. PYRENE COMPANY, LIMITED, Great West Road, Brentford, Middx.

"CONYMEL"—Electric wires and cables. CONNOLLY'S (BLACKLEY), LIMITED, Blackley Vale Mills, Blackley, Manchester.

"FARRATUBE" — Water-tube boilers. FARRAR BOILERWORKS, LIMITED, The Spitals, Northgate, Newark-on-Trent, Notts.

"SCRIVEN"—Machine tools. CROSTHWAITE FURNACES & SCRIVEN MACHINE TOOLS, LIMITED, York Street Iron Works, Leeds.

"PYROBAR"—Electric heating elements. BRITISH-THOMSON HOUSTON COMPANY, LIMITED, Crown House, Aldwych, London, W.C.2.

"DURASLEEVEX"—Insulators in the form of sleevings. DURATUBE & WIRE, LIMITED, 16, Hanworth Road, Feltham, Middx.

"BUSLAY"—Electric relay systems. METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, Number One, Kingsway, London, W.C.2.

"HKP"—Cutting and metal working tools. H. K. PORTER, INC., c/o McKenna & Company, 14, Waterloo Place, Pall Mall, London, S.W.1.

"SPEEDWELL"—Welding rods of common metal. HAGGERTY, LAWRANCE & COMPANY, 43, Cadwallon Road, New Eltham, London, S.E.9.

"PIGETUBE"—Tubing or sleeving for electric insulation. PIRELLI-GENERAL CABLE WORKS, LIMITED, 343/5, Euston Road, London, N.W.1.

"SUPERMEL"—Electric wires and cables. W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, Milton Court, Westcott, Dorking, Surrey.

IN PARLIAMENT

Steel Supplies

MR. ELLIS SMITH asked the Minister of Production if he was satisfied with the supply of steel; had any orders or delivery dates been delayed because of steel supply difficulties; what action was to be taken to expedite and increase the supplies of steel; and had any action been taken to increase the productive capacity of the steel industry.

MR. OLIVER LYTTELTON replied that steel supplies were in general adequate to meet essential war needs. The difficulties that had arisen from time to time had not been abnormal, being mainly related to particular classes of steel. These had been largely overcome. Shipping difficulties placed some limit on the expansion of steel supplies, but our limited native resources in raw materials had been, and were being, adapted to the utmost to supply the types of iron and steel required for the war effort.

MR. ELLIS SMITH: Is he satisfied that the present productive capacity of steel will meet the needs of the Ministry of Production?

MR. LYTTELTON: Yes. If account is taken of importations, our total productive capacity of steel is sufficient to keep up our full war effort, but we have to rely on balanced quantities from the U.S.A.

SEGREGATION OF ALLOY STEEL SCRAP

A colour scheme, which it is hoped will assist workpeople and managements in war factories to segregate essential alloy steel scrap more effectively, has been devised by the Iron and Steel Control. In future the following colours will be used to identify the various grades:—Carbon (white); nickel (red); nickel-chrome (blue); nickel-chrome-molybdenum (green); manganese-molybdenum (brown); carbon-chrome [ball bearing] (black); chrome-molybdenum (orange); stainless (pink).

Producing works are urged to do everything possible to avoid mixing alloy steel scrap with carbon scrap, and alloy steel scrap should be sorted into appropriate grades. Scrap merchants should make sure they do not mix grades when collecting.

To advise managements on effective measures for the adequate segregation of alloy steel scrap a number of inspectors have been appointed by the Ministry of Supply. They are attached to the Scrap Department of the Iron and Steel Control, Ashorne Hill, Leamington Spa, Warwickshire, to which all correspondence should be addressed.

A RESEARCH SCHOLARSHIP of the value of £400 per annum and tenable for two years has been offered by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by the Institution of Naval Architects,

NEWS IN BRIEF

UP TO FEBRUARY 13, the latest available return, the total weight of railings scrap recovered throughout England, Scotland and Wales was 447,671 tons. Yorkshire's yield was 41,318 tons.

MR. WALTER ARNOLD BLACKBURN, 29, Broadway North, Walsall, Staffs, retired ironfounder, is paying statutory interest at 4 per cent. per annum. The interest is payable on March 26 at the Official Receiver's Office, 37, Temple Street, Birmingham, 2.

A MEETING OF the Institution of Mechanical Engineers (North-Western Branch) will be held on Saturday, March 13, at the Engineers' Club, Albert Square, Manchester, at 2.30 p.m., when a Paper entitled "Developments in Cast Irons and Their Engineering Applications" will be given by Mr. J. G. Pearce.

ROBERT FLEMING & COMPANY, bankers, are offering to purchase for cash the whole or any less number of the shares to which, under the capital rearrangement scheme, shareholders of the Wigan Coal & Iron Company, Limited, are entitled in the Lancashire Steel Corporation, Limited. The prices offered, free of commission, are 19s. 9d. per share for the £1 5½ per cent. non-cumulative redeemable second preference shares and 22s. for the £1 "A" ordinary shares.

EMPLOYEES at T. W. Greenwell & Company's shipyard, Sunderland, have made a presentation to Mr. John S. Martin, works manager, in recognition of the part he played in salvaging two British destroyers which had become stranded on the North-East Coast. Speaking at the presentation, Mr. T. G. Greenwell, managing director, said that one of the vessels caught fire, and the story how Mr. Martin and his men tackled the job of patching her up and getting her off the rocks into the River Wear was a real epic.

THE EMPLOYMENT OF WOMEN (Control of Engagement Order, 1943, which came into force recently, controls the engagement of women aged 18 to 40 inclusive, the upper age limit of control having previously been 30. All women between 18 and 40 will now be required to obtain their employment through a local office of the Ministry of Labour and National Service, or an agency approved under the Order, and employers will be able to engage, or seek to engage, such women only by applying through a local office or an approved agency.

THE NATIONAL ARBITRATION TRIBUNAL have given their decision in a dispute between the Rose Street Foundry & Engineering Company, Limited, Inverness, and members of the Amalgamated Engineering Union in their employ at the Rose Street Foundry and Thornbush Slipway as fitters, turners, machinists and other engineering workers, including apprentices. The claim was for rates of wages and allowances not less favourable than those observed by the Aberdeen and District Association of the Engineering and Allied Employers' National Federation for ship repair work. The Tribunal found against the claim and awarded accordingly.

THE FIRST ANNUAL REPORT of the Combined Raw Materials Board has been issued. It states that agreement has been secured through the Board between the Governments concerned to take action in regulating supply, distribution and use of the major strategical materials, with the object of ensuring that each country is put in a position to make its maximum contribution to the war effort on the production side. This common action, based in the first instance on an assured allocation to each Government in proportion to demonstrated needs and available supplies, has extended to common measures of restriction and interchange of technical information and experience.

LORD NUFFIELD has intimated his intention of founding forthwith a charitable trust, which will be known as "The Nuffield Foundation." He will hand over to trustees his shareholdings in the Nuffield organisation to the value of £10,000,000 as a capital fund. The income from this fund will be administered by managing trustees. Lord Nuffield is not in any way withdrawing from his association with his businesses, with which he will be personally identified in the same way as heretofore. The objects which the trustees will endeavour to assist are:—Medical research and teaching; the organisation and development of medical and health services; scientific research and teaching in the interests of trade and industry; the pursuit of social studies; the care and comfort of aged persons.

OBITUARY

MR. ALBERT EDWARD ROBINSON, a director of W. H. Robinson, Limited, scrap metal and machinery makers, Milnsbridge, Huddersfield, died recently. He was 61.

MR. ARTHUR MARSHALL, chairman of Thomas Marshall & Company (Loxley), Limited, fireclay refractories manufacturers, Loxley, Sheffield, died on February 28, aged 73.

MR. JOHN GEMMILL GOURLAY, who died at Pretoria recently was traffic superintendent of the South African Iron & Steel Industrial Corporation, Limited, Iscor Works, Pretoria.

MR. C. J. BAGLEY, former managing director of the Cargo Fleet Iron Company, Limited, and a director of the South Durham Steel & Iron Company, Limited, who died at Hartburn, Stockton, last week, in his 95th year, was one of the early pioneers of the steel trade on the North-East Coast. Born in the County of Durham, he received his early training at the Consett Ironworks and subsequently spent over half a century on Tees-side, where his first appointment was that of general manager of the Tees Bridge Ironworks at Stockton. He laid down the first steel plant at the Moor Works, Stockton, which afterwards became the property of the South Durham Steel & Iron Company, and it was only recently that he relinquished his seat on the board of that company. He was a past-president of the Cleveland Institution of Engineers and was believed to be the oldest member of the Iron and Steel Institute.

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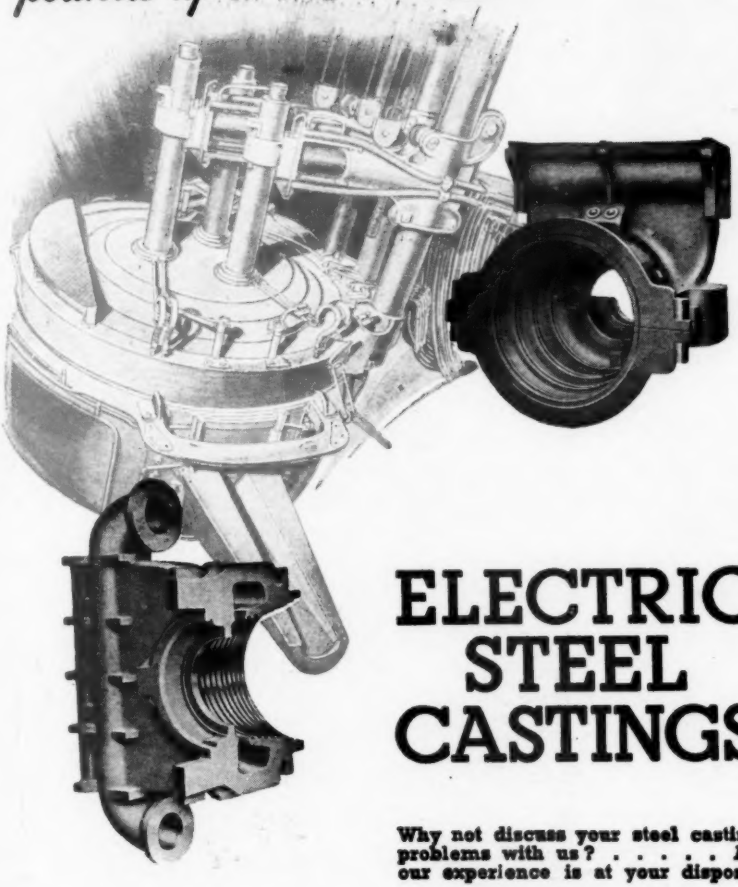

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